Remarks/Arguments

Applicants respectfully requests further examination and reconsideration in view of the amendments above and arguments set forth fully below. Claims 1-66 were previously pending in the present application. Within the Office Action, Claims 1-66 stand rejected. By way of the above amendments, Claims 1, 16, 28, 40, and 52 are amended. Accordingly, Claims 1-66 are currently pending in this application.

Amendments to the Specification

By the above amendments to the specification, typographical errors are corrected. These amendments are made such that the reference numerals within the specification match those within the Figures. Additionally, previously missing serial numbers and filing dates related to references cited are added. No new matter is added by way of these amendments.

Objections to the Claims

Within the Office Action, it is noted that in Claim 52, "loss" should be amended to "lose" to correct a typographical error. By the above amendments, Claim 52 is amended to replace "loss" with "lose".

Rejections under 35 U.S.C. §102

Within the Office Action, Claims 1, 2, 4, 6, 13-17, 19, 21, 28, 29, 31, 33, 40, 41, 43, 45, 52, 53, 55, 57, and 64-66 stand rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,763,951 to Hamilton et al. (hereafter "Hamilton"). The Applicants respectfully traverse this rejection for the following reasons.

Hamilton teaches a cooling system in which a non-mechanical magnetic pump is used to move electrically conductive fluid through a fluid path. The fluid path is contained completely within a circuit board assembly (Hamilton, col. 8, lines 48-49). In particular, Hamilton teaches a circuit board (elements 106 and 108 in Figure 3, and elements 151 and 164 in Figure 4) in which a channel (118, 156, 162) is formed. A coolant 116 is pumped through the channels by a magnetic pump (114, 154). The channels are formed so that the coolant absorbs heat energy from a semiconductor chip (100, 152). The circuit board and attached fins (110) act as a liquid to air heat exchanger (Hamilton, col. 5, lines 10-11) so that coolant heated by the absorbed heat energy is cooled by air flow. In this manner, Hamilton teaches a modified circuit board that

includes channels there within, where the modified circuit board is an integrated device that functions as both a heat exchanger (taking heat from the semiconductor chip to the coolant) and a heat rejector (removing heat from the coolant to the air). This integrated device includes channels formed therein for transporting the coolant within the integrated device. Hamilton does not teach fluid lines. Further, Hamilton does not teach a cooling system that includes a heat exchanger, a heat rejector, and a pump as independent components, where the components are coupled via fluid lines. Instead, Hamilton teaches channels formed within a circuit board material. Still further, Hamilton does not teach using fluid lines to transport coolant between components within a cooling system.

Additionally, there is no hint, teaching, or suggestion within Hamilton as to the diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined.

The present invention is directed to a closed loop fluid system that is hermetic and is configured to minimize loss of the fluid in the system due to leakage at interconnect points and to diffusion of the fluid through the materials of the various components within the cooling system. Configuring the cooling system according to specific design dimensions, using specific materials, and using specific sealing methodologies, the cooling system maintains a total volume of the fluid above a predetermined quantity over a desired amount of time. The present cooling system achieves a hermetic environment by utilizing components which comprise the desired dimensions and materials to minimize the fluid loss over a predetermined amount of time. Such components include, but are not limited to, the heat exchanger 102, the heat rejector 104, the pump 106 and fluid lines 108 (present specification, Figure 1). Consideration is also be made for the interconnections between each of the components and the potential fluid loss resulting therefrom.

The amended independent Claim 1 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components <u>including fluid lines</u> to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein <u>the closed loop fluid pumping system loses up to a predetermined maximum amount of the fluid over a desired amount of</u>

operating time. As discussed above, Hamilton does not teach fluid lines. Further, Hamilton does not teach using fluid lines to transport coolant between components within a cooling system. Still further, Hamilton does not teach a diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined. For at least these reasons the independent Claim 1 is allowable over the teachings of Hamilton.

Because Claims 2, 4, 6, and 13-15 depend from allowable Claim 1, they are each also in a condition for allowance.

The amended independent Claim 16 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses less than 0.89 grams of fluid per year. As discussed above, Hamilton does not teach fluid lines. Further, Hamilton does not teach using fluid lines to transport coolant between components within a cooling system. Still further, Hamilton does not teach a diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined. For at least these reasons the independent Claim 16 is allowable over the teachings of Hamilton.

Because Claims 17, 19, and 21 depend from allowable Claim 16, they are each also in a condition for allowance.

The amended independent Claim 28 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses less than 1.25 grams of fluid per year. As discussed above, Hamilton does not teach fluid lines. Further, Hamilton does not teach using fluid lines to transport coolant between

components within a cooling system. Still further, Hamilton does not teach a diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined. For at least these reasons the independent Claim 28 is allowable over the teachings of Hamilton.

Because Claims 29, 31, and 33 depend from allowable Claim 28, they are each also in a condition for allowance.

The amended independent Claim 40 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components <u>including fluid lines</u> to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein <u>the closed loop fluid pumping system loses less than 2.5 grams of fluid per year</u>. As discussed above, Hamilton does not teach fluid lines. Further, Hamilton does not teach using fluid lines to transport coolant between components within a cooling system. Still further, Hamilton does not teach a diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined. For at least these reasons the independent Claim 40 is allowable over the teachings of Hamilton.

Because Claims 41, 43, and 45 depend from allowable Claim 40, they are each also in a condition for allowance.

The amended independent Claim 52 is directed to a method of manufacturing a closed loop fluid pumping system to control the temperature of an electronic device. The method comprises forming at least one heat exchanger to be configured in contact with the electronic device and to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, forming at least one pump, forming at least one heat rejector, forming fluid interconnect components <u>including fluid lines</u>, and coupling the at least one heat exchanger to the at least one pump and to the at least one heat rejector using the fluid interconnect components, thereby forming the closed loop fluid pumping system, wherein <u>the closed loop fluid pumping system is formed to lose less than a predetermined amount of the fluid over a desired amount of</u>

operating time. As discussed above, Hamilton does not teach fluid lines. Further, Hamilton does not teach using fluid lines to transport coolant between components within a cooling system. Still further, Hamilton does not teach a diffusion rate of the coolant through any of the materials of the circuit board or substrate within which the channels are formed. Therefore, the diffusion rate of the fluid out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Hamilton, over any given period of time, can not be determined. For at least these reasons the independent Claim 52 is allowable over the teachings of Hamilton.

Because Claims 53, 55, 57, and 64-66 depend from allowable Claim 52, they are each also in a condition for allowance.

Within the Office Action, Claims 1-8, 13-23, 28-35, 40-47, 52-59, and 64-66 stand rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent Application Serial No. 2004/0052049 to Wu et al. (hereafter "Wu"). The Applicants respectfully traverse this rejection for the following reasons.

Wu teaches a cooling system for cooling a CPU, the cooling system includes an absorption section 001 and a radiation section 002. The absorption section 001 includes a coolant storage unit 103, an absorption layer 104 between the coolant storage unit 103 and a CPU 105, and a conduit 106 through which a coolant 102 flows. The absorption layer 104 is placed on top of the CPU 105 and absorbs heat from the CPU 105. The heat is passed from the absorption layer 104 to the coolant flowing through the conduits 106. The radiation section 002 includes a fan 115, a plurality of radiation sheets 114, and the conduits 106. Coolant 102 heated within the absorption section 001 flows into the radiation section 002 via the conduits 106, where the fan blows air over the conduits 106 to cool the coolant 102 flowing therethrough. The coolant 102 is pumped through the conduits 106 using a power pump included within the absorption section 001.

Wu teaches that the coolant storage unit , the power pump, and the radiator section are joined together by welding (Wu, paragraph [0022]). In particular, Wu teaches that each junction point within the cooling system is closely welded, and specifically, that the conduit 106 is connected to the inlet 112 and the outlet 111 of the coolant storage unit 103 by way of a welding process (Wu, paragraphs [0023] and [0025]). Wu does not teach any further details as to the welding material used or the dimensions and nature of the welded connections made.

Within the Office Action, it is stated that the cooling system of Wu has substantially zero fluid loss. Specifically, it is concluded that since the components of the cooling system are

sealed together by welding, there is substantially zero fluid loss in the system of Wu. The Applicants respectfully disagree with this conclusion. As described in detail in the present application, fluid loss is in part due to leakage at connections within a system. However, fluid loss also results from diffusion, or permeation, of the fluid through the materials of the components used within the system. As such, the cooling system of Wu is susceptible to fluid loss due to connection leakage and to diffusion.

It is well known in the art of welding that a solder is used to connect pieces being soldered together. As such, solder is used to weld the conduits 106 of Wu are to the coolant storage unit 103. As a result, diffusion of the coolant 102 is a function of the coolant permeation rate through the solder at the point where the conduit 106 is solder connected to the coolant storage unit 103 (for example, at the inlet 112 and at the outlet 111). There is no hint, teaching, or suggestion within Wu that indicates the type of solder used and the permeability rate of the solder material. Further, there is no hint, teaching, or suggestion within Wu that indicates the dimensions of the solder exposed to the coolant 102 that passes by the soldered area of the conduit 106/coolant storage unit 103 connection. As described in the present application, the permeation rate of a sealing material (e.g. the solder) is proportional to the seal area divided by the seal length (present specification, page 17, lines 18-19). The present application describes various methods of manipulating theses dimensions in order to reduce the permeation rate below a desired level. Since none of these dimensions are specified within Wu, the permeation rate at the soldered connection of Wu can not be determined. Therefore, the permeation rate of the coolant 102 through the solder can not be determined. As such, the amount of coolant lost from the cooling system 101 of Wu, over any given period of time, can not be determined.

The amended independent Claim 1 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses up to a predetermined maximum amount of the fluid over a desired amount of operating time. As discussed above, Wu does not teach a diffusion rate of the coolant through either the conduit material, the cooling storage unit material, or the solder used to connect the conduits to the cooling storage unit. Therefore, the diffusion rate of the coolant out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling

system of Wu, over any given period of time, can not be determined. For at least these reasons the independent Claim 1 is allowable over the teachings of Wu.

Because Claims 2-8 depend from allowable Claim 1, they are each also in a condition for allowance.

The amended independent Claim 16 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses less than 0.89 grams of fluid per year. As discussed above, Wu does not teach a diffusion rate of the coolant through either the conduit material, the cooling storage unit material, or the solder used to connect the conduits to the cooling storage unit. Therefore, the diffusion rate of the coolant out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Wu, over any given period of time, can not be determined. For at least these reasons the independent Claim 16 is allowable over the teachings of Wu.

Because Claims 17-23 depend from allowable Claim 16, they are each also in a condition for allowance.

The amended independent Claim 28 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses less than 1.25 grams of fluid per year. As discussed above, Wu does not teach a diffusion rate of the coolant through either the conduit material, the cooling storage unit material, or the solder used to connect the conduits to the cooling storage unit. Therefore, the diffusion rate of the coolant out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Wu, over any given period of time, can not be determined. For at least these reasons the independent Claim 28 is allowable over the teachings of Wu.

Because Claims 29-35 depend from allowable Claim 28, they are each also in a condition

for allowance.

The amended independent Claim 40 is directed to a closed loop fluid pumping system to control a temperature of an electronic device. The system comprises at least one pump, at least one heat exchanger coupled to the electronic device and configured to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, at least one heat rejector, and fluid interconnect components including fluid lines to couple the at least one pump, the at least one heat exchanger and the at least one heat rejector, wherein the closed loop fluid pumping system loses less than 2.5 grams of fluid per year. As discussed above, Wu does not teach a diffusion rate of the coolant through either the conduit material, the cooling storage unit material, or the solder used to connect the conduits to the cooling storage unit. Therefore, the diffusion rate of the coolant out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Wu, over any given period of time, can not be determined. For at least these reasons the independent Claim 40 is allowable over the teachings of Wu.

Because Claims 41-47 depend from allowable Claim 40, they are each also in a condition for allowance.

The amended independent Claim 52 is directed to a method of manufacturing a closed loop fluid pumping system to control the temperature of an electronic device. The method comprises forming at least one heat exchanger to be configured in contact with the electronic device and to pass a fluid therethrough, wherein the fluid performs thermal exchange with the electronic device, forming at least one pump, forming at least one heat rejector, forming fluid interconnect components including fluid lines, and coupling the at least one heat exchanger to the at least one pump and to the at least one heat rejector using the fluid interconnect components, thereby forming the closed loop fluid pumping system, wherein the closed loop fluid pumping system is formed to lose less than a predetermined amount of the fluid over a desired amount of operating time. As discussed above, Wu does not teach a diffusion rate of the coolant through either the conduit material, the cooling storage unit material, or the solder used to connect the conduits to the cooling storage unit. Therefore, the diffusion rate of the coolant out of the cooling system can not be determined. As such, the amount of coolant lost from the cooling system of Wu, over any given period of time, can not be determined. For at least these reasons the independent Claim 52 is allowable over the teachings of Wu.

Because Claims 53-59 and 64-66 depend from allowable Claim 52, they are each also in a condition for allowance.

Rejections under 35 U.S.C. §103

Within the Office Action, Claims 9, 11, 12, 24, 26, 27, 36, 38, 39, 48, 50, 51, 60, 62, and 63 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of U.S. Patent No. 5,043, 797 to Lopes. The Applicants respectfully traverse this rejection for the following reasons.

Claims 9, 11, and 12 are dependent on the independent Claim 1. Claims 24, 26, and 27 are dependent on the independent Claim 16. Claims 36, 38, and 39 are dependent on the independent Claim 28. Claims 48, 50, and 51 are dependent on the independent Claim 40. Claims 60, 62, and 63 are dependent on the independent Claim 52. As discussed above, the independent Claims 1, 16, 28, 40, and 52 are allowable. As such, each of the dependent Claims 9, 11, 12, 24, 26, 27, 36, 38, 39, 48, 50, 51, 60, 62, and 63 are each also allowable as being dependent upon an allowable base claim.

Within the Office Action, Claims 10, 25, 37, 49, and 61 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Lopes and further in view of U.S. Patent No. 6,351,384 to Daikoku et al. (hereafter "Daikoku"). The Applicants respectfully traverse this rejection for the following reasons.

Claim 10 is dependent on the independent Claim 1. Claim 25 is dependent on the independent Claim 16. Claim 37 is dependent on the independent Claim 28. Claim 49 is dependent on the independent Claim 40. Claim 61 is dependent on the independent Claim 52. As discussed above, the independent Claims 1, 16, 28, 40, and 52 are allowable. As such, each of the dependent Claims 10, 25, 37, 49, and 61 are each also allowable as being dependent upon an allowable base claim.

For the reasons given above, the Applicants respectfully submit that the claims are in a condition for allowance, and allowance at an early date would be appreciated. If the Examiner has any questions or comments, he is encouraged to call the undersigned at (408) 530-9700 so that any outstanding issues can be expeditiously resolved.

Respectfully submitted,
HAVERSTOCK & OWENS LLP

Dated: 5-23-05

By: Thomas B. Haverstock

Thomas B. Haverstock
Reg. No.: 32,571
Attorneys for Applicants

CERTIFICATE OF MAILING (37 CFR§ 1.8(a))

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450

HAVERSTOCK & OWENS LLP.

Date: 5/23/05 By: